CENTER FOR NONDESTRUCTIVE CHARACTERIZATION

Fast Nanoscale Imaging: High-Resolution, Multidimensional Characterization

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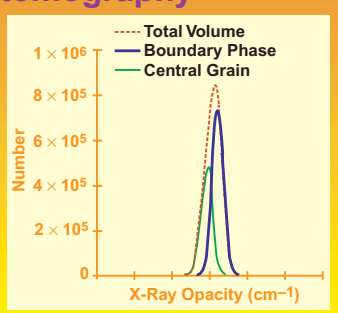
Objective #2. Fast nanoscale imaging to provide programs with quantitative, multidimensional imaging down to nanoscale lengths—spatial resolution of 100 nm over a 1-mm field of view.

Achievements

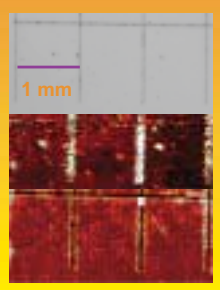
Synchrotron Microtomography

CT image of a high-explosive material



Prill texture has been determined as being caused by enrichment of binder at the particle boundaries. Material opacities of the particle and boundary phases of the explosive were separated with monochromatic x-rays and high resolution (left image) and analyzed for the first time (right image).

Photothermal imaging



By using a CCD array, we increased the speed of photothermal imaging 6 orders of magnitude for thin-film characterization. This leap in speed makes photothermal imaging a viable technique to characterize full-sized production parts rather than being limited to laboratory studies of small samples.

Fast Tabletop Tomography

Microfocus computed tomography with a CMOS imaging panel and CsI scintillator has demonstrated improvements in image acquisition time with capability for imaging larger objects at higher magnification

CT of human vertebrae

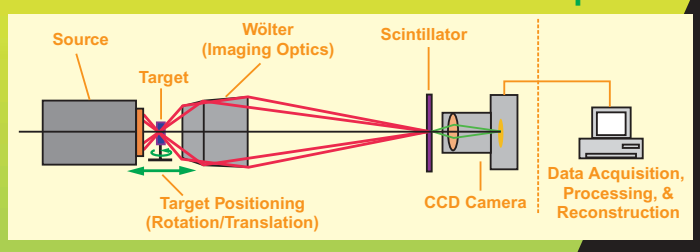
CT of ceramic sample showing Mo-rich higher-density region (light area) near top surface

Progress

Acoustic Microscope

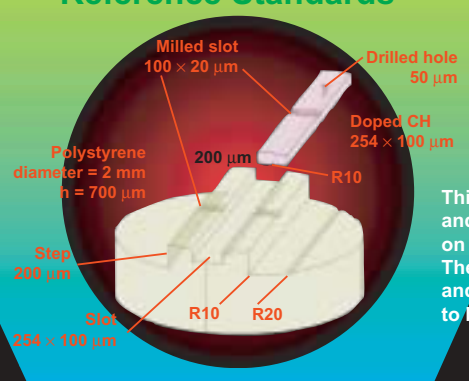
We are developing an acoustic microscope with submicrometer precision staging over 0.5-m range. This ultrasonic image of a penny is taken at 53 μm spatial resolution using a 75 MHz transducer frequency.

Wölter X-ray Microscope



This x-ray microscope is expected to produce tomographic images of mesoscale objects with 1-μm spatial resolution over a 250-μm field of view with high-throughput speeds (minutes per image in a lab environment).

Reference Standards



This reference standard has cylindrical geometry and contains features and artifacts similar to those on a Super-Nova Rayleigh-Taylor (SNRT) target. The artifacts were designed for manufacturability and to provide a range of features that can be used to benchmark NDC methods.

future directions

- Next-generation sources, detectors, and optics
- Near-field imaging

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